

Mycologists Help Guard U.S. Borders

They may study simple plants, but some fungi experts are part of a complicated mission—shielding American agriculture from harmful pests.

Agricultural materials—crops, plants, plant products, and nursery stock—that arrive at U.S. ports must be examined for nonnative, potentially invasive pests such as fungi, especially those of quarantine significance. Tasked with scanning myriad agricultural products for fungal diseases, port identifiers are sometimes stumped by a particularly enigmatic specimen.

That's when they call in the experts—mycologists who work for the Agricultural Research Service (ARS) and USDA's Animal and Plant Health Inspection Service (APHIS).

Mary E. Palm, APHIS's national mycologist, is first on the list to identify fungi that are intercepted during inspection at U.S. ports. She's based at ARS's Systematic Botany and Mycology Laboratory (SBML) in Beltsville, Maryland, so that she has access to its top-notch mycologists, fungal collections, and databases on the location of fungi around

the world. The U.S. National Fungus Collections, part of SBML, are the largest reference collections of fungi in the world.

"I use the lab's host fungus records, keys, descriptions, and computerized information to make an identification that ultimately determines whether the agricultural material in question will be

ARS and APHIS experts work together to keep out foreign fungi.

allowed in the country, destroyed, or shipped back to its place of origin," explains Palm.

This self-described detective also relies on ARS mycologists like Amy Y. Rossman, who heads SBML, or Gary J. Samuels. "If I look at a fungus and nothing seems to fit, I'll ask one of them," says Palm.

These scientists—who can differentiate molds with names that most people would be challenged to pronounce—study systematics, which is the science of discovering and organizing biological diversity. They are continuously naming,

classifying, and describing fungi, bringing order to this largely uncharted world of organisms.

The language they use—to discuss genera with names like *Phomopsis*, *Colletotrichum*, and *Cryphonectria*, plus thousands of others and their associated species—is critical to efforts to solve agricultural problems.

"A name is more than just a label," says Rossman. "When it's a result of detailed observation and knowledge, a name will accurately communicate and predict biological information about a given fungus so that scientifically sound decisions can be made." Rossman served as national mycologist for APHIS before Palm.

Knowing Our Fungal Foes

Fungal systematics can have a dramatic effect on decisions about global transport and trade in crops and plants. For instance, ARS scientists brought clarity to the confusion about the Karnal bunt fungus, *Tilletia indica*, in the United States in 1996. SBML's Lisa A. Castlebury determined that the fungus that had worried American wheat growers in the Southeast and threatened the nation's wheat export market was actually an imposter, a Karnal bunt look-alike. The new species she described was *Tilletia walkeri*, or ryegrass bunt.

SBML researchers are also shedding light on the potentially trade-restricting fungi of flowers of the family Proteaceae. Native to the southern hemisphere and predominantly found and grown in South Africa, proteas produce bright, exotic-looking flowers sought after by the cut-flower industry. But while these blooms are fit for bouquets, they are also fine hosts to a range of fungi.

"To protect the protea industry in the United States, APHIS phytosanitary regulations may sometimes result in rejection of shipments from South Africa before they can reach U.S. markets," explains Palm.

PEGGY GREB (K11055-1)



Mycologists Mary Palm (left) and Amy Rossman discuss the identification of a rust fungus.

PEGGY GREB (K11064-1)



Fungal spots on a protea leaf from South Africa.

Aiming to create a comprehensive resource for growers, plant pathologists, and the regulatory entities who make quarantine decisions, Palm and South African colleagues are busy writing a book—already a couple inches thick—on the different fungi that occur on proteas. The book, which will include the protea fungi that exist in the United States, Africa, and Australia, should help facilitate the flow of usable and innocuous plant materials among these countries.

Rossman and Palm both note that more and more fungal specimens in need of investigation are coming through SBML's doors.

"I think the driving force is the growing desire for new flowers and horticultural plants," says Palm.

But an old favorite, the dogwood tree, has also benefited from the sleuthing of SBML. Dogwoods, including the flowering varieties grown in the East and the Pacific dogwood found in the Pacific Northwest, are being threatened by an anthracnose fungus. Beyond affecting the spring-blooming trees that are used for landscaping, the fungus is invading native stands of dogwoods that provide critical food and cover for wildlife.

"The fungus is a serious pathogen," says Rossman. "Most notably, it's killed a lot of dogwoods in the woods of Catoctin Mountain Park, in Maryland."

Causing coal-colored blotches on

SCOTT BAUER (K5879-2)



Flora Patterson: First Woman Mycologist at USDA

Fungal systematics' key role in global trade dates back to the 1910 famous gift of flowering cherry trees to the United States from Japan. Those pastel-petalled ornamentals were a welcome addition to the then-dismal environment of the capital city's developing parkland. On arrival, though—instead of just flowers—the trees were also found to be adorned with fungal and insect pests.

Flora Patterson, a USDA pathologist, and her colleagues realized the inherent danger posed by the diseased trees and, in a politically risky move, recommended they be destroyed. Her suggestion was heeded, thereby preventing the possible introduction of invasive fungi and other pests into this country. Patterson had a 30-year career with USDA, during which she added 96,000 specimens to the U.S. National Fungus Collections.

Interestingly, nearly all the national mycologists for the last century have been women. Starting with the most recent, they have been: Mary E. Palm, Amy Y. Rossman, Flora G. Pollock, Alice J. Watson, Anna E. Jenkins, Vera K. Charles, and Flora W. Patterson. John M. McKemy recently joined Palm as a second national mycologist.—By **Erin Peabody**, ARS.

PEGGY GREB (K11078-1)



An arrangement of protea flowers, two each of, from left, Pink Mink, Duchess, and Pin Cushion. In the background are two leafy leucadendron Safari Sunset proteas.



Erin McCray, collections manager, and David Farr, mycologist for ARS, examine a fusiform rust of pine, one of more than 1 million specimens in the U.S. National Fungus Collections.

diseased leaves, the fungus appeared simultaneously on both U.S. coasts, but no one knew exactly what the causal agent was. Former SBML researcher Scott Redlin described the fungal pathogen, *Discula destructiva*, a previously unknown species, thereby laying the foundation for research on this important disease.

Other fungal pathogens requiring the detective work of the Beltsville lab include daylily rust fungus; canker-causing fungi of the genus *Nectria*, which attack hardwood trees like beech, yellow birch, black walnut, and red oak; and the fungus that produces scab on poinsettia.

Every day, Palm receives packages containing carefully wrapped rusts, molds, and mildews from around the globe. On one day in October, her subjects are chrysanthemum leaves. She's focusing on the buff-colored spots, only millimeters across, encrusting the lower surface of the foliage. She recognizes the culprit immediately: *Puccinia horiana*. To nonscientists: white rust.

"The specimen was sent to us from a woman whose garden club bought infested chrysanthemum plants from a nursery in another state. She had even planted

some of them in her yard," says Palm.

Palm was able to swiftly confirm what untrained eyes couldn't. And a good thing! White rust, which originated in eastern Asia, is a serious pest affecting garden and pot mums. The fungus produces a type of spore—a basidiospore—that can be spread from plant to plant by wind or splashing water. If left unchecked, it could cost the country's burgeoning horticulture and floral industries millions of dollars.

Challenges—and Compensations

The mycologists quickly agree on their biggest hurdle: a lack of knowledge about the breadth and diversity of fungi worldwide.

"In making an identification, we'll often know the fungus' genus, but not its species, and there can be a significant difference between two species of the same genus. Sometimes, a lot of money can be at stake, as in the case of Karnal bunt," says Rossman.

To further prove her point about challenges faced by SBML mycologists, Rossman holds up a 3- to 4-inch reference book that lists the fungi known to

exist in the United States and says, "I could go out tomorrow and find 20 species that aren't in this book."

While the mycologists' decisions do have serious implications, Rossman and Palm note that their work does have its lighter side. For example, the national mycologist before Rossman, Flora Pollack, once described a new fungus that occurs on melon, so she had the honor of naming it. Because the organism shoots out relatively large, round, black spores, she chose *Monosporascus cannonballus*.

"This is proof that mycologists do have a sense of humor," Palm says.—
By **Erin Peabody**, ARS.

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